CLAIMS

What is claimed is:

1. A method of operating a hydraulic system in which a hydraulic actuator and a control valve are connected in series in a circuit branch between a supply line containing pressurized fluid and a return line connected to a tank, said method comprising:

specifying a desired velocity for the hydraulic actuator;

sensing a parameter which varies with changes of a force acting on the hydraulic actuator;

deriving an equivalent flow coefficient in response to the desired velocity and the parameter, wherein the equivalent flow coefficient characterizes fluid flow in the hydraulic circuit branch; and

operating the control valve in response to the equivalent flow coefficient to control the fluid in the circuit branch.

2. The method as recited in claim 1 wherein sensing a parameter comprises sensing hydraulic pressure produced by the force acting on the hydraulic actuator.

3. The method as recited in claim 1 further comprising:

calculating a pressure setpoint based on the equivalent flow coefficient; and

controlling pressure in at least one of the supply line and the return line in response to the pressure setpoint.

4. The method as recited in claim 3 further comprises sensing pressure in the supply line to produce a supply pressure measurement; and wherein calculating a pressure setpoint also is based on the supply pressure measurement.

5. The method as recited in claim 3 further comprises sensing pressure in the return line to produce a return pressure measurement; and wherein calculating a pressure setpoint also is based on the return pressure measurement.

6. The method as recited in claim 3 further comprising:

sensing a pressure produced by the force acting on the hydraulic actuator to produce an actuator pressure measurement; and

wherein calculating a pressure setpoint also is based on the actuator pressure measurement.

7. The method as recited in claim 1 further comprising:

sensing at least one of pressure in the supply line and pressure in the return line to produce a pressure measurement set; and

wherein deriving an equivalent flow coefficient also is based on the pressure measurement set.

8. The method as recited in claim 1 wherein controlling the fluid in the hydraulic system comprises using the parameter to control pressure in at least one of the supply line and the return line in response to the force acting on the hydraulic actuator.

9. In a hydraulic system having a circuit branch in which a first electrohydraulic proportional valve couples a first port of a hydraulic actuator to a supply line containing pressurized fluid and a second electrohydraulic proportional valve couples a second port of the hydraulic actuator to a return line connected to a tank, a method comprising:

specifying a desired velocity for the hydraulic actuator;

sensing a parameter which varies with changes of a force acting on the hydraulic actuator;

deriving an equivalent flow coefficient in response to the desired velocity and the parameter, wherein the equivalent flow coefficient characterizes fluid flow through the circuit branch; and

operating the first and the second electrohydraulic proportional valves in response to the equivalent flow coefficient to control flow of fluid to and from the actuator.

10. The method as recited in claim 9 wherein operating the first and the second electrohydraulic proportional valves comprises:

deriving a first flow coefficient which characterizes fluid flow through the first electrohydraulic proportional valve;

deriving a second flow coefficient which characterizes fluid flow through the second electrohydraulic proportional valve;

operating the first electrohydraulic proportional valve in response to the first flow coefficient; and

operating the second electrohydraulic proportional valve in response to the second flow coefficient.

11. The method as recited in claim 9 wherein sensing a parameter comprises sensing hydraulic pressure produced by the force acting on the hydraulic actuator.

12. The method as recited in claim 9 further comprising:

calculating a pressure setpoint based on the equivalent flow coefficient; and

controlling pressure in at least one of the supply line and the return line in response to the pressure setpoint.

13. The method as recited in claim 9 wherein the hydraulic actuator comprises a cylinder and a piston which defines first and second chambers in the cylinder, wherein the piston has a first surface area in the first chamber and a second surface area in the second chamber.

14. The method as recited in claim 13 wherein the equivalent flow coefficient is derived based on the surface area of the piston in at least one of the first chamber and the second chamber.

15. The method as recited in claim 14 further comprising producing a commanded velocity for the piston; and wherein the equivalent flow coefficient is derived further based on the commanded velocity.

16. In a hydraulic system having a circuit branch in which a first electrohydraulic proportional valve couples a first port of a hydraulic actuator to a supply line containing pressurized fluid, and a second electrohydraulic proportional valve couples a second port of the hydraulic actuator to the supply line, a third electrohydraulic proportional valve couples the first port to a return line connected to a tank, and a fourth electrohydraulic proportional valve couples the second port to the return line, a method comprising:

specifying a desired velocity at which the hydraulic actuator is to move;

sensing a parameter which varies with changes of a force acting on the hydraulic actuator;

designating given ones of the first, second, third and fourth electrohydraulic proportional valves to be operated to produce the desired velocity of the hydraulic actuator

deriving an equivalent flow coefficient in response to the desired velocity and the parameter, wherein the equivalent flow coefficient represents fluid flow in the hydraulic circuit branch; and

activating the given ones of the first, second, third and fourth electrohydraulic proportional valves in response to the equivalent flow coefficient to move the hydraulic actuator at the desired velocity.

17. The method as recited in claim 16 wherein activating each given one of the first, second, third and fourth electrohydraulic proportional valves comprises:

deriving a valve flow coefficient which characterizes fluid flow through the given one of the first, second, third and fourth electrohydraulic proportional valves; and

operating the given one of the first, second, third and fourth electrohydraulic proportional valves in response to the valve flow coefficient.

18. The method as recited in claim 16 further comprising:

sensing pressure in the supply line;

sensing pressure in the return line;

sensing pressure at the first port; and

sensing pressure at the second port;

wherein deriving an equivalent flow coefficient is further in response to pressures sensed in the supply line, in the return line, at the first port, and at the second port.

19. The method as recited in claim 16 wherein sensing a parameter comprises sensing a pressure produced in the hydraulic system by the force acting on the hydraulic actuator.

20. The method as recited in claim 16 further comprising:

calculating a pressure setpoint based on the equivalent flow coefficient; and

controlling pressure in at least one of the supply line and the return line in response to the pressure setpoint.